EXHIBIT 16

FEASIBILITY STUDY REPORT
GROUNDWATER REMEDIATION
BRIDGETON LANDFILL
ST. LOUIS COUNTY, MISSOURI

Prepared for:

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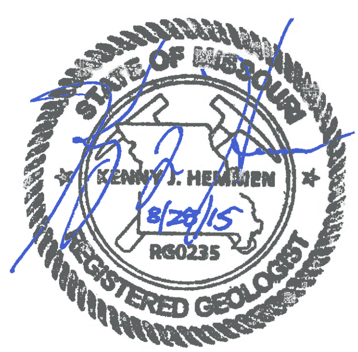
Geotechnology Project No. J024889.02



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FEASIBILITY STUDY REPORT
GROUNDWATER REMEDIATION
BRIDGETON LANDFILL
ST. LOUIS COUNTY, MISSOURI

EXECUTIVE SUMMARY

This Feasibility Study Report (FS) presents the results of preliminary evaluation of potential groundwater remediation alternatives at Bridgeton Landfill in St. Louis County, Missouri (Plate 1). For purposes of this FS, the contributing sources to groundwater contamination are the North Quarry and South Quarry solid waste landfill areas located within the footprint of the Bridgeton Landfill property (Site). Both of these inactive solid waste landfill areas were operated using permits issued by the Missouri Department of Natural Resources (MDNR). Preliminary costs included herein are based on experience with related types of projects and from feasibility level cost information provided by suppliers/vendors. The main findings from the FS activities are summarized below:

- Remedial Action Objectives (RAOs) are medium-specific goals for the Site that are protective of human health and the environment. Remedial alternatives were evaluated for compliance with RAOs to assess the protectiveness of each alternative. The preliminary remedial action objective was developed based on Site data, experience, and consideration of applicable or relevant and appropriate requirements (ARARs). The purpose of the RAO is to:

  Protect human health by eliminating exposure (i.e., direct contact, ingestion, and inhalation) to groundwater with concentrations of contaminants of concern (COCs) above regulatory or risk-based standards.

- Five remedial alternatives were evaluated for this FS and include:

  Remedial Alternative 1 - No Action: The remedial alternative of no action was considered and is a baseline to compare the other potential remedial alternatives.

  Remedial Alternative 2 - Monitored Natural Attenuation (MNA): MNA is defined as the use of natural attenuation processes within the context of a carefully controlled and monitored Site cleanup approach that will reduce contaminant concentrations to levels that are protective of human health and the environment within a reasonable time frame. Natural attenuation includes the physical, chemical, and biological processes that reduce the mass, toxicity, mobility, volume, or concentration of contaminants. MNA is not a no action alternative, but rather, an alternative that requires extensive monitoring, data evaluation, and risk assessment considerations.

Remedial Alternative 3 – MNA and Barrier Treatment: Alternative 3 is the same as Alternative 2 with the addition of a barrier treatment zone along the west and southwest downgradient perimeter of the Site. The barrier treatment is a supplement to MNA and should provide increased in-situ sorption and bioremediation to enhance the reduction in groundwater concentrations of COCs. Various types of barrier treatments are available to enhance bioremediation and in-situ treatment of contaminants. Creation of an effective treatment barrier requires an overlapping continuous barrier over a sufficient area. Once in the aquifer, the treatment material will sorb to or reside in the soil matrix and enhance bioremediation and contaminant sorption. Pilot testing would be required during the remedial design phase to assess the effectiveness of a barrier treatment zone.

Remedial Alternative 4 – Hydraulic Containment: Alternative 4 includes hydraulic containment of contaminated groundwater using a series of groundwater extraction wells along the west and southwest downgradient perimeter of the Site. Substantial additional data collection, including a groundwater pump test and treatability study, would be needed during the remedial design phase. Extracted groundwater would be treated via an on-site treatment system. Treated groundwater would be discharged via a pipeline to be constructed and extended to the Missouri River. Groundwater monitoring of an off-site groundwater monitoring network is included.

Remedial Alternative 5 – Groundwater Containment Wall: The construction of a groundwater containment wall (GCW) consists of mixing in-situ alluvial soils (typically clay and sand) with injected bentonite grout to construct a continuous low permeability wall that will contain contaminated groundwater within alluvium at the Site. The base of the GCW would be keyed into weathered bedrock. The feasibility level concept is that the GCW would be approximately 8,700 feet long, 20 inches wide and average 100 feet deep. Groundwater monitoring of an off-site groundwater monitoring network is included.

- The United States Environmental Protection Agency (USEPA) has established seven primary criteria for evaluating remedial alternatives. The criteria, in part, provide a basis for selecting an applicable remedial alternative. Below is a summary of the criteria in relation to the remedial alternatives.

Overall Protection of Human Health and the Environment: Taking no action is not protective of human and the environment because institutional controls are not required and no monitoring will be conducted to identify if groundwater conditions change and cause increased risk. Assuming groundwater contamination at concentrations above regulatory or risk-based levels has not migrated to the west of the proposed off-site monitoring well network, and the

indoor inhalation pathway does not pose a risk, Alternatives 2, 3, 4 and 5 are protective of human health and the environment.

Compliance with ARARs: MNA complies with ARARs. Barrier treatment will need to comply with possible ARARs regarding injection of chemicals into groundwater. Pilot testing of barrier treatment will need to evaluate possible adverse water quality conditions created by injection of barrier treatment materials. Hydraulic containment and groundwater treatment by air stripping will need to comply with air and surface water discharge regulations.

Long-Term Effectiveness and Permanence: Each alternative (except no action) includes institutional controls to reduce potential exposure to untreated groundwater until cleanup levels are achieved. Alternatives 2 through 5 provide similar levels of long term effectiveness and permanence. Alternatives 3 through 5 may reduce the remedial time frame in comparison to MNA.

Reduction in Toxicity, Mobility or Volume through Treatment: Alternatives 3 through 5 involve treatment methods that reduce toxicity, mobility and volume of affected groundwater.

Short Term Effectiveness: Each of the alternatives would be implemented in accordance with an approved Health and Safety Plan (HASP). Barrier treatment could cause adverse water quality conditions due to the injected materials. Additional Site evaluation is needed to assess the potential remedial time frames associated with Alternatives 2 through 5.

Implementability: Alternatives 2 through 5 would require access agreements and regulatory approvals prior to implementation. Each alternative can be implemented using available methods and technology. Implementation of a barrier treatment system may include regulatory approval that is needed for injection of treatment materials into groundwater. Hydraulic containment has the most components associated with implementation (i.e., extraction wells, extensive piping network, substantial treatment system, pipeline construction, permits, operation and maintenance (O&M) requirements).

Cost: The preliminary present value costs for Alternatives 2 through 5, assuming that treatment and monitoring will require 30 years to complete, are as follows:

Alternative 2	$ 5,640,772
Alternative 3	$13,391,769
Alternative 4	$14,501,653
Alternative 5	$32,780,138

Alternative 2 is the most cost effective alternative. Below is a summary of Alternative 2 costs compared to Alternatives 3 through 5 costs.

Alternative 3 – approximately 2.37 times greater
Alternative 4 – approximately 2.57 times greater
Alternative 5 – approximately 5.81 times greater

Due to the feasibility level and conceptual level definition of the remedial alternatives, in our opinion, the present value costs may be considered within the following accuracy ranges. Due to inadequate Site data, more accurate cost information is not available at this time.

Alternative 2:	-30 to +50 percent	cost range $3,948,540 to $8,461,158
Alternative 3:	-30 to +50 percent	cost range $9,374,239 to $20,087,654
Alternative 4:	-50 to +100 percent	cost range $7,250,827 to $29,003,306
Alternative 5:	-30 to +50 percent	cost range $22,946,097 to $49,170,207

1.0 INTRODUCTION

This Feasibility Study Report (FS) presents the results of preliminary evaluation of potential groundwater remediation alternatives at Bridgeton Landfill in St. Louis County, Missouri (Plate 1). For purposes of this FS, the contributing sources to groundwater contamination are the North Quarry and South Quarry solid waste landfill areas (see Appendix A) located within the footprint of the Bridgeton Landfill property (Site). Both of these solid waste landfill areas were operated using permits issued by the MDNR. A main purpose of the FS was to evaluate preliminary groundwater remedial alternatives and associated preliminary cost information to be used as part of litigation between the Office of the Missouri Attorney General and Republic Services, Inc. et al.

This FS includes information that is at the conceptual level or screening level of detail and is limited due to a lack of adequate Site characterization data and a lack of risk assessment information including ecological risk information. For example, the extent of off-site groundwater impacts has not been defined, so it is difficult to evaluate remedial alternatives, risks, and costs. These limitations affect the degree of project or remedial alternative definition, which directly affects the accuracy of preliminary cost information. As additional Site information is developed, the evaluation of the remedial alternatives will be increased and the accuracy of the associated cost information will be improved. Preliminary costs included herein

are based on our experience with related types of projects and from feasibility level cost information provided by suppliers/vendors.

2.0 BACKGROUND

2.1 Site Overview. As summarized in the reports referenced herein, the subject property shown on Plate 1 consists of several distinct areas (see Appendix A). Operable Unit 1 (OU1) consists of Radiological Areas 1 and 2, which contain radiologically impacted materials (RIM) associated with the West Lake Landfill. OU2 consists of the remainder of the property (non-RIM areas) and includes the inactive sanitary landfill, closed demolition landfill and the inactive North Quarry and South Quarry solid waste landfill areas. The approximate sizes of these specific areas are summarized below:

- Property Footprint - 238 acres (includes Republic Services business/hauling operations)
- OU1 – 41 acres
- North Quarry - 16 acres
- South Quarry - 35 acres
- Closed Demolition Landfill - 25 acres
- Inactive sanitary landfill – 47 acres

2.2 Site Information. For purposes of preparing this FS, we relied primarily on the following Site information/reports:

1. *Groundwater Monitoring Report, October 2013 Additional Groundwater Sampling Event, West Lake Landfill Operable Unit 1, Bridgeton, Missouri;* prepared for the Missouri/Kansas Remedial Branch - Superfund Division, U.S. Environmental Protection Agency - Region 7; prepared by Engineering Management Support, Inc.; report dated February 21, 2014 (Copy provided in Appendix A).

2. *Background Groundwater Quality, Review of 2012-14 Groundwater Data, and Potential Origin of Radium at the West Lake Landfill Site, St. Louis, County, Missouri*; prepared for the U.S. Environmental Protection Agency, Region 7; prepared by the U.S. Geological Survey, Missouri Water Science Center, report dated December 17, 2014.

3. *Draft Hydrogeologic Characterization Report for The Bridgeton Active Sanitary Landfill, Bridgeton, Missouri*; prepared for Laidlaw Waste Systems, Inc.; prepared by Golder Associates; Project No. 943-2848; report dated September 1995.

Site data and associated maps included in the above reports provide the main technical basis that there are documented releases from the North and South Quarry solid waste landfill areas to groundwater. For example, these two unlined solid waste landfill areas relied substantially on an inward hydraulic gradient to control releases to groundwater. Site data demonstrates that an inward hydraulic gradient has not been maintained, which contributes to releases to groundwater. As indicated in the February 21, 2014 Engineering Management Support, Inc. report, the most commonly detected volatile organic compound (VOC) in groundwater was benzene, which was reported to be present in 36 of the 84 monitoring wells located on or near the Site. Also noted in the referenced report is that benzene was detected in 18 monitoring wells at concentrations greater than its water quality standard of 5 micrograms per liter (ug/l). As such, VOCs and, in particular benzene, is a main focus for potential groundwater remediation at the Site.

Site data indicates that the groundwater flow direction in the area of the Site is towards the west/northwest and the Missouri River. Hydraulic gradients in bedrock at the Site indicate, in part, groundwater flow from bedrock into the alluvium. Site hydraulic gradient data indicates that some portion of the groundwater contamination that originates from the North and South Quarry solid waste landfill areas and moves into the adjacent bedrock will eventually migrate and flow into the alluvium on the west portion of the Property. Site data also indicates that portions of the North Quarry solid waste landfill area are in hydraulic connection with alluvium. Migration of groundwater contamination in deeper bedrock and below the alluvium is unknown at this time due to a lack of Site data. A general (east to west) subsurface profile through the South Quarry area is presented on Plate 2.

Other items related to impacts to off-site groundwater include possible effects to property values and placement of institutional controls (e.g., deed restrictions) on affected properties to manage potential groundwater ingestion risks and indoor vapor inhalation risks. Individual property parcels located near the Site are shown on Plate 3.

The Site and vicinity properties are currently served by a piped, potable water source. Based on a review of MDNR records, properties in the vicinity of the landfill do not currently use private groundwater wells for potable water. Based on the availability of piped, potable water and the lack of private wells in the area of the Site, it is reasonable to assume that groundwater in the vicinity of the Site will likely not be used as a potable water source.

The Site is located in a primarily commercial/industrial area. Current receptors include occupants of commercial/industrial buildings near the Site. Future residential properties, non-residential properties, and construction workers are also possible receptors.

Indoor inhalation of vapors from impacted groundwater is a potentially complete exposure pathway in the vicinity of the Site. Additionally, the construction worker exposure pathway exists for current and future construction activities in the vicinity. In our opinion, due to the lack of groundwater supply wells near the Site, and the availability of piped, potable water, the groundwater ingestion exposure pathway is not reasonably likely to be complete in the future at or near the Site. St. Louis County does not have an ordinance prohibiting the installation of potable drinking water wells. The future groundwater ingestion exposure pathway could be eliminated by implementing a durable institutional control (i.e., deed restriction) that prohibits potable water well installation on impacted properties.

The Missouri River is located approximately 7,000 feet west of the Site. Additional evaluation is needed to assess the potential risk to ecological receptors in the vicinity of the Site.

3.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

3.1 General. Remedial Action Objectives (RAOs) are risk-based goals for the Site that are protective of human health and the environment. Remedial alternatives are evaluated and compared with the RAOs to assess the protectiveness of each alternative.

USEPA guidance indicates that Site actions must meet federal and state standards, requirements, criteria or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARs). State ARARs must also be met if they are more stringent than federal requirements. ARARs are one of the main criteria considered during the development of remedial alternatives.

Based on the lack of Site data regarding the delineation of off-site impacts to groundwater, several major assumptions were developed to assist with evaluating remedial alternatives. For purposes of the FS, we assume that effects to groundwater from the North and South Quarry solid waste landfill areas that may be present west of the Site and beyond the influence of the proposed remedial alternatives (i.e., west of the off-site sentinel well network) are below risk-based concentrations and do not pose a risk to human health and the environment.

If this assumption is not accurate and off-site groundwater impacts are found to be present west of the off-site sentinel well network at concentrations above risk-based concentrations, then substantial modifications to the proposed remedial alternatives will be required.

3.2 Remedial Action Objectives. RAOs are medium-specific goals for the Site that are protective of human health and the environment. Remedial alternatives were evaluated for compliance with RAOs to assess the protectiveness of each alternative. The preliminary RAO was developed based on Site data, experience, and consideration of ARARs. The RAO is to:

- Protect human health by eliminating exposure (i.e., direct contact, ingestion, and inhalation) to groundwater with concentrations of COCs above regulatory or risk-based standards.

3.3 Identification of ARARs. There are three types of ARARs including: 1) chemical-specific, 2) action-specific, and 3) location-specific. Chemical-specific ARARs are acceptable exposure concentrations and may be appropriate remediation goals. Action-specific ARARs relate to restrictions that may apply to a certain activity, treatment or disposal activity. Location-specific ARARs establish criteria for activities within ecologically sensitive or other regulated areas. Preliminary ARARs are summarized in Table 1.

A primary focus is to meet chemical-specific ARARs in consideration of Site risks. Chemical-specific ARARs establish the acceptable amounts or concentrations of a chemical that may be found in, or discharged to the ambient environment. Action-specific and location-specific ARARs are met by appropriate implementation of a remedial alternative.

4.0 IDENTIFICATION AND SCREENING OF REMEDIAL ALTERNATIVES

4.1 General. Remedial alternatives were selected based on several factors including groundwater sampling and testing results, Site conditions, and experience. Several types of technologies and methods were considered as part of the remedial alternative evaluation.

Institutional controls and property use restrictions (e.g., prohibit potable water well installation) are required for each of the alternatives (except no action) to eliminate the exposure pathway for untreated groundwater at off-site affected properties until cleanup levels are achieved.

4.2 Potential Remedial Alternatives. Five remedial alternatives were evaluated as summarized below. Except for Alternative 1 – No Action, each alternative includes substantial additional Site characterization, groundwater flow modeling, risk assessment, groundwater monitoring and institutional controls. Discreet depth, direct push (e.g., GeoProbe) groundwater

sampling and testing (i.e., additional Site characterization) should be performed within the alluvium on-site and off-site prior to implementing the proposed additions to the groundwater monitoring network.

Remedial Alternative 1 - No Action

Remedial Alternative 2 - MNA

Remedial Alternative 3 – MNA and Barrier Treatment

Remedial Alternative 4 – Hydraulic Containment

Remedial Alternative 5 – Groundwater Containment Wall

4.2.1 Remedial Alternative 1 - No Action. The remedial alternative of no action was considered and is a baseline to compare to the other potential remedial alternatives.

4.2.2 Remedial Alternative 2 – Monitored Natural Attenuation. Remedial Alternative 2 is MNA combined with institutional controls to prohibit use of affected groundwater until cleanup levels are achieved. A concept of this alternative is provided on Plate 4. MNA is defined as the use of natural attenuation processes within the context of a carefully controlled and monitored Site cleanup approach that will reduce contaminant concentrations to levels that are protective of human health and the environment within a reasonable time frame. Natural attenuation includes the physical, chemical, and biological processes that reduce the mass, toxicity, mobility, volume, or concentration of contaminants. MNA is not a no action alternative, but rather, an alternative that requires extensive monitoring, data evaluation, and risk assessment considerations.

USEPA has issued guidance that provides a framework for evaluating MNA as a remedial alternative. Several factors to consider for evaluating MNA include:

- Whether the contaminants present in groundwater can be effectively remediated by natural attenuation processes;
- Whether or not the contaminant plume is stable and the potential for the environmental conditions that influence plume stability to change over time;
- Whether human health, drinking water supplies, other groundwater, surface waters, ecosystems, sediments, air or other environmental resources could be adversely impacted as a consequence of selecting MNA as the remediation option;

- Current and projected demand for the affected resource over the time period that the remedy will remain in effect;

- Whether the contamination, either by itself or as an accumulation with other nearby sources (on-site or off-site), will exert a long-term detrimental impact on available water supplies or other environmental resources;

- Whether the estimated timeframe of remediation is reasonable compared to timeframes required for other more active methods (including the anticipated effectiveness of various remedial approaches on different portions of the contaminated soil and/or groundwater);

- The nature and distribution of sources of contamination and whether these sources have been, or can be, adequately controlled;

- Whether the resulting transformation products present a greater risk, due to increased toxicity and/or mobility, than do the parent contaminants;

- The impact of existing and proposed active remediation measures upon the MNA component of the remedy, or the impact of remediation measures or other operations/activities (e.g. pumping wells) in close proximity to the Site; and

- Whether reliable site-specific mechanisms for implementing institutional controls (e.g. zoning ordinances) are available, and if an institution responsible for their monitoring and enforcement can be identified.

The above items will require further evaluation based on the results of substantial additional Site characterization during the remedial design phase. The feasibility of MNA would be based, in part, on the adequacy of source control measures including leachate and landfill gas removal at the North and South Quarry solid waste disposal areas.

4.2.3 Remedial Alternative 3 – MNA and Barrier Treatment. Alternative 3 is the same as Alternative 2 with the addition of a barrier treatment zone along the west and southwest downgradient perimeter of the Site. A concept of this alternative is provided on Plate 5. Technical and preliminary cost information for the barrier treatment is provided in Appendix B. The barrier treatment is a supplement to MNA and should provide increased in-situ sorption and bioremediation. Pilot testing would be required during the remedial design phase to assess the effectiveness of a barrier treatment zone at the Site.

4.2.4 Remedial Alternative 4 – Hydraulic Containment. Alternative 4 includes hydraulic containment of contaminated groundwater along the west and southwest downgradient perimeter of the Site. Hydraulic containment includes a series of groundwater extraction wells and an on-site treatment system with discharge of treated groundwater to the Missouri River. Our feasibility level evaluation indicates that the total volume of extracted groundwater to achieve hydraulic containment in the alluvium is greater than 1,000 gallons per minute (gpm). A concept of Alternative 4 is shown on Plate 6. For Alternative 4, substantial additional data collection, including a groundwater pump test and treatability study, is needed during the remedial design phase.

4.2.5 Remedial Alternative 5 – Groundwater Containment Wall. Alternative 5 includes a groundwater containment wall (GCW) along the south, west, and north portions of the Site that are underlain by alluvium. The groundwater containment wall consists of mixing in-situ alluvial soils with injected bentonite grout to construct a continuous, low-permeability wall that will contain contaminated groundwater with alluvium at the site. A concept of Alternative 5 is shown on Plate 7.

5.0 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

5.1 General. A detailed evaluation of each remedial alternative is presented in this section of the FS report. For purposes of this FS, we assessed each alternative relative to the seven criteria typically used by USEPA and summarized below. Preliminary conceptual level costs were developed for each alternative. The preliminary cost information is limited by the lack of Site characterization data and risk assessment information. Project budgets should be developed during the remedial design phase and should be based on bids from contractors and other applicable sources.

5.2 Evaluation Criteria. USEPA has established seven primary criteria for evaluating remedial alternatives. The criteria, in part, provide a basis for selecting an applicable remedial alternative. A brief description of the evaluation criteria is presented below.

Overall Protection of Human Health and the Environment - This threshold criterion is used to evaluate the ability of the remedial alternative to protect human health and the environment. Pathways of concern are discussed in relation to how the alternative addresses potential risks and what mechanism such as treatment or institutional controls are used to address risks. Each remedial alternative must meet this criterion.

Compliance with ARARs - This threshold criterion is used to evaluate compliance with the three types of ARARs (chemical, location, and action-specific). ARARs are discussed in relation to each alternative and how compliance will be attained. The remedial alternatives must meet this criterion.

Long-Term Effectiveness and Permanence - This balancing criterion is used to evaluate the alternatives ability to reduce potential exposure and risk. The magnitude of residual risks and the reliability of controls are addressed. The remedial alternatives are evaluated for the best result among the balancing criteria.

Reduction of Toxicity, Mobility, or Volume through Treatment - This balancing criterion is used to evaluate the proposed treatment processes, anticipated concentration reductions, and residuals that may remain after treatment.

Short-Term Effectiveness - This balancing criterion is used to evaluate the potential risks during implementation of the alternative to Site workers and nearby residents. Possible environmental impacts and mitigation options during implementation are considered. The time required to achieve RAOs is considered given adequate Site information.

Implementability - This balancing criterion is used to evaluate the ability to implement an alternative including the reliability of the technology, monitoring the technology, and ability to construct and operate the technology. Administrative issues such as permits, access, and approvals are considered.

Cost - This balancing criterion is used to evaluate the costs of the alternatives. The preliminary cost information includes engineering, construction and operation and maintenance costs. For each alternative, the preliminary cost information is presented as present value costs over an assumed 30 year operating period.

5.3 Detailed Evaluation of Remedial Alternatives. The detailed evaluation was conducted for the potential remedial alternatives listed below:

Remedial Alternative 1 - No Action

Remedial Alternative 2 - MNA

Remedial Alternative 3 – MNA and Barrier Treatment

Remedial Alternative 4 – Hydraulic Containment

Remedial Alternative 5 – Groundwater Containment Wall

Note that each alternative includes the use of institutional controls such as a deed restriction to reduce possible exposure to affected groundwater. In addition, Alternatives 2 through 5 include a groundwater monitoring program and contingency plan.

5.3.1 Remedial Alternative 1 - No Action. The remedial alternative of no action is usually considered as a baseline with which to compare the other potential remedial alternatives.

5.3.1.1 Alternative 1 - Description. No active remediation or monitoring would occur as part of the no action alternative. Natural processes would act to reduce groundwater concentrations over time. Groundwater monitoring would not be used to track effects to groundwater.

5.3.1.2 Alternative 1 - Overall Protection of Human Health and the Environment. Although documentation would not be available, given enough time, the no action alternative may be protective. Overall, we do not consider no action to be protective. Monitoring is not part of this alternative and would not be used to demonstrate protection to human health and the environment. Institutional controls would not be used to reduce potential exposure to untreated groundwater.

5.3.1.3 Alternative 1 - Compliance with ARARs. Action-specific and location-specific ARARs are not applicable because no remedial actions are planned. Chemical-specific ARARs could be achieved through attenuation processes over time. Monitoring would not be conducted to document groundwater conditions in comparison to ARARs.

5.3.1.4 Alternative 1 - Long-Term Effectiveness and Permanence. Alternative 1 could provide long term risk reduction through natural attenuation processes; however, monitoring is not part of the no action alternative. Documenting reductions through natural processes would not occur without monitoring. Institutional controls or property use restrictions would not be used to reduce potential exposure to untreated groundwater.

5.3.1.5 Alternative 1 - Reduction of Toxicity, Mobility, or Volume through Treatment. Active treatment would not be performed using the no action alternative. Reduction of toxicity, mobility, or volume through treatment would not be measured.

5.3.1.6 Alternative 1 - Short-Term Effectiveness. The no action alternative has no short term effects. The time to reach the RAOs would not be measured because monitoring would not occur.

5.3.1.7 Alternative 1 - Implementability. There are no implementation issues for the no action alternative.

5.3.1.8 Alternative 1 - Cost. Implementation of the no action alternative has no associated costs.

5.3.2 Remedial Alternative 2 - Monitored Natural Attenuation. MNA is a potential remedial alternative for the Site. MNA is a common approach that would require substantial additional data collection during the remedial design phase.

5.3.2.1 Alternative 2 - Description. MNA is defined as the use of natural attenuation processes within the context of a carefully controlled and monitored Site cleanup approach that will reduce contaminant concentrations to levels that are protective of human health and the environment within a reasonable time frame. Natural attenuation includes the physical, chemical, and biological processes that reduce the mass, toxicity, mobility, volume, or concentration of contaminants. MNA is not a no action alternative but rather an alternative that requires extensive monitoring, data evaluation, and risk assessment considerations.

5.3.2.2 Alternative 2 - Overall Protection of Human Health and the Environment. Deferred - Conclusions about this criteria are deferred due to lack of off-site groundwater data.

Within the context of the assumptions indicated in Section 3.1, this alternative would provide protection of human health and the environment over time due to naturally occurring processes. Reductions in groundwater concentrations would be tracked using an extensive monitoring program. Contingency measures would be in place if Site monitoring data indicated unacceptable risks in the future. Institutional controls or deed restrictions that prohibit the installation of drinking water wells at affected properties would be used to reduce potential exposure to untreated groundwater. Given successful implementation of MNA, RAOs would be achieved at the Site. A contingency plan is a major part of a MNA approach and would be implemented if unacceptable risks developed due to unexpected data trends, land or groundwater use changes, and risks to receptors.

5.3.2.3 Alternative 2 - Compliance with ARARs. Natural attenuation processes would achieve chemical-specific ARARs over time. Groundwater monitoring would be used to assess when chemical-specific ARARs are achieved. MNA would meet location-specific and action-specific ARARs.

5.3.2.4 Alternative 2 - Long-Term Effectiveness and Permanence. Natural attenuation processes acting over time would be effective for achieving the RAO. Reductions in concentrations would be tracked using an extensive groundwater monitoring program. Monitoring data would be used to ensure reduced risk and

effectiveness. Property use restrictions would be effective to reduce potential ingestion of untreated groundwater until the remedy is complete. MNA is a reliable alternative that can be verified through effective monitoring. The time required to achieve RAOs may be substantial using MNA.

5.3.2.5 Alternative 2 - Reduction of Toxicity, Mobility, or Volume through Treatment. Reductions in groundwater concentrations would occur due to natural processes, which will reduce toxicity, mobility, and volume.

5.3.2.6 Alternative 2 - Short-Term Effectiveness. There are not substantial short-term effects associated with this alternative. Groundwater monitoring at the Site would be conducted in accordance with a HASP. Periodic monitoring reports would be submitted to regulatory agencies.

5.3.2.7 Alternative 2 - Implementability. This alternative can be readily implemented with the necessary personnel and equipment. Property use restrictions and access agreements would be negotiated with individual property owners. Regulatory or local approvals are not anticipated.

5.3.2.8 Alternative 2 - Cost. Preliminary present value cost for a 30-year MNA approach is $5,640,772. Details of the cost and assumptions are in Table 2. Present value cost allows different alternatives to be compared on the basis of one cost.

Preliminary costs for MNA are presented in Table 2. MNA is proposed on a semi-annual basis for a 30-year period. The monitoring program includes sampling and testing of up to 99 monitoring wells. The MNA concept includes approximately 54 existing monitoring wells and 45 additional monitoring wells to be installed west of the Site (Plate 4). In general, Alternative 2 includes the following cost items:

- Site access coordination,
- Site logistical coordination,
- Project management,
- Field observation and documentation of well installation activities,
- Geophysical utility locating,
- Air knife buried utility exploration,
- Continuous soil sampling and logging,
- Drill rig mobilization and borehole advancement,
- Monitoring well installation and materials,
- Dedicated sample tubing and pump installation and materials,
- Monitoring well surface completions,
- Monitoring well development,

- Decontamination of equipment and personnel,
- Drill cutting containment, analysis, and disposal,
- Development/purge water containment, analysis, and disposal,
- Submittal of MDNR well certifications,
- Surveying locations and measuring point elevations,
- Semi-annual groundwater sample collection and analysis (Appendix 1 list – MO landfill regulations),
- Biennial groundwater analysis (Appendix 2 list - MO landfill regulations), and
- Well installation and semi-annual groundwater sampling reports.

5.3.3 Remedial Alternative 3 – MNA and Barrier Treatment. This alternative employs the same institutional controls and MNA as Alternative 2. In addition to MNA, barrier treatment would be conducted using numerous injection locations and commercially available remediation materials to enhance bioremediation and in-situ sorption. A concept of Alternative 3 is provided on Plate 5.

5.3.3.1 Alternative 3 – Description. Various types of barrier treatments are available to enhance bioremediation and in-situ treatment of contaminants. Information about one type of barrier treatment, liquid activated carbon, is provided in Appendix B.

A main objective in enhancing bioremediation is to increase the rate and extent of microbial degradation. A primary method for enhancing bioremediation is to increase microbial activity by addressing limiting factors (i.e., electron donors, electron acceptors, primary substrate). Materials needed for enhanced bioremediation are commonly injected in a liquid form using borings. The process requires the material to be mixed with water to form an injectable slurry which is then pressure injected (using a pump) into the zone of contamination. Creation of an effective treatment barrier requires that the treatment form an overlapping continuous barrier over a sufficient area. Once in the aquifer, the material will sorb to or reside in the soil matrix and enhance bioremediation and contaminant sorption.

Use of a barrier treatment to supplement MNA may result in a shorter remedial timeframe than use of only MNA. Barrier treatment may provide additional risk reduction to potential off-site receptors. Pilot testing of the barrier treatment material would be required during the remedial design. Various types of barrier treatment materials would be further evaluated during the remedial design phase.

5.3.3.2 Alternative 3 - Overall Protection of Human Health and the Environment. Deferred - Conclusions about this criteria are deferred due to the lack of off-site groundwater data.

Within the context of the assumptions indicated in Section 3.1, this alternative would provide protection of human health and the environment over time due to naturally occurring processes that are supplemented by the barrier treatment. Reductions in groundwater concentrations would be tracked using an extensive monitoring program. Contingency measures would be in place if Site monitoring data indicated unacceptable risks in the future. Institutional controls or deed restrictions that prohibit the installation of drinking water wells at affected properties would be used to reduce potential exposure to untreated groundwater. Given successful implementation of MNA and barrier treatment, RAOs would be achieved at the Site. A contingency plan is a major part of a MNA and barrier treatment approach and would be implemented if unacceptable risks developed due to unexpected data trends, land or groundwater use changes, and risks to receptors. Institutional controls or deed restrictions that prohibit the installation of drinking water wells at affected properties would be used to reduce potential exposure to untreated groundwater.

5.3.3.3 Alternative 3 - Compliance with ARARs. This method would achieve the chemical-specific ARARs by removing potential VOCs from groundwater. Pilot testing would be performed during the remedial design phase. Groundwater monitoring would be used to assess when chemical-specific ARARs are achieved. MNA and barrier treatment would need to meet action-specific ARARs related to injection of treatment materials into groundwater.

5.3.3.4 Alternative 3 - Long-Term Effectiveness and Permanence. Natural attenuation processes acting over time and supplemented by barrier treatment would be effective for achieving the RAO. Reductions in concentrations would be tracked using an extensive groundwater monitoring program. Monitoring data would be used to assess reduced risk and effectiveness. Property use restrictions would be effective to reduce potential ingestion of untreated groundwater until the remedy is complete.

5.3.3.5 Alternative 3 - Reduction of Toxicity, Mobility, or Volume through Treatment. Use of this alternative would permanently remove constituents from groundwater. This approach meets the preference for treatment technologies that permanently reduce the toxicity, mobility or volume of the hazardous substances.

5.3.3.6 Alternative 3 - Short-Term Effectiveness. The alternative can be implemented without causing increased risk to the community and workers during construction and implementation. Groundwater monitoring and placement of the barrier treatment at the Site would be conducted in accordance with a HASP.

5.3.3.7 Alternative 3 - Implementability. This alternative can be readily implemented with the necessary personnel, equipment, and materials. Property use restrictions and access agreements would be negotiated with individual property owners.

5.3.3.8 Alternative 3 - Cost. Preliminary costs for Alternative 3 are summarized in Table 3. Barrier treatment information is in Appendix B. The main cost components are similar to Alternative 2 with the addition of the barrier treatment design, pilot testing, and barrier treatment installation.

The preliminary 30-year present value cost for MNA and barrier treatment is $13,391,769 (conceptual only). As with the other remedial alternatives being evaluated, present value cost allows different alternatives to be compared on the basis of one cost.

5.3.4 Remedial Alternative 4 – Hydraulic Containment. Alternative 4 is hydraulic containment that would be implemented on the downgradient perimeter of the Site. A concept of Alternative 4 is provided on Plate 6.

5.3.4.1 Alternative 4 - Description. Alternative 4 includes hydraulic containment of affected groundwater along the west and southwest downgradient perimeter of the Site. Substantial additional data collection, including a groundwater pump test and treatability study, would be needed during the remedial design phase. Extracted groundwater would be treated via an on-site treatment system. Treated groundwater would be discharged via a pipeline to be constructed to the Missouri River.

5.3.4.2 Alternative 4 - Overall Protection of Human Health and the Environment. Deferred - Conclusions about this criteria are deferred due to the lack of off-site groundwater data.

Within the context of the assumptions indicated in Section 3.1, this alternative would achieve the RAO and provide protection of human health and the environment over time through hydraulic containment and removal of contaminants. Institutional controls or deed restrictions that prohibit the installation of drinking water wells at affected properties would be used to reduce potential exposure to

untreated groundwater. Reductions in groundwater concentrations would be tracked using an extensive monitoring program. Contingency measures would be in place if Site monitoring data indicated unacceptable risks in the future.

5.3.4.3 Alternative 4 - Compliance with ARARs. This treatment alternative would achieve the chemical-specific ARARs by permanently removing constituents from groundwater in the subject area. Groundwater monitoring data would be used to assess when chemical-specific ARARs are achieved.

Treatment system discharges to air and water would need to be evaluated further to assess location-specific and action-specific ARARs.

5.3.4.4 Alternative 4 - Long-Term Effectiveness and Permanence. Hydraulic containment would be effective for achieving the RAO. Reductions in concentrations would be tracked using an extensive groundwater monitoring program. Monitoring data would be used to evaluate reduced risk and effectiveness. Property use restrictions would be effective to reduce potential ingestion of untreated groundwater until the remedy is complete. Hydraulic containment is a reliable alternative that can be verified through effective monitoring.

5.3.4.5 Alternative 4 - Reduction of Toxicity, Mobility, or Volume through Treatment. Use of this alternative would permanently remove constituents from groundwater. This alternative meets the preference for treatment technologies that permanently reduce the toxicity, mobility or volume of the constituents of concern.

5.3.4.6 Alternative 4 - Short-Term Effectiveness. Potential worker exposure to affected groundwater during construction, operation, and maintenance activities would be mitigated through the use of personal protective equipment (PPE) and a HASP.

5.3.4.7 Alternative 4 - Implementability. Hydraulic containment components are conventional and commercially available. Property access agreements and deed restrictions would be negotiated with individual property owners. Substantial additional Site data would need to be collected during the remedial design phase.

5.3.4.8 Alternative 4 - Cost. The preliminary present value costs for the hydraulic containment alternative is $14,501,653 (Table 4). Additional costs of Alternative 4 would need to be developed during the remedial design phase, which

will include substantial additional data collection. Preliminary costs associated with air stripping treatment are provided in Appendix C. In general, the Alternative 4 preliminary cost summary includes the following items (conceptual only):

- Site access/utility coordination,
- Project management,
- Site characterization,
- Groundwater flow model,
- Permits, plans, surveying, utilities,
- Containment system and treatment system design,
- Treatment system and building construction
- Extraction well installation
- Piping installation
- Field observation,
- As-built survey, construction completion report,
- Operation and maintenance,
- Institutional controls,
- Monitoring well network installation,
- Groundwater sampling and testing, and
- Groundwater reporting (semi-annual)

5.3.5 Remedial Alternative 5 – Groundwater Containment Wall. Remedial Alternative 5 includes the construction of a GCW around the south, west and north areas of the property. A concept of Alternative 5 is provided on Plate 7. Substantial additional evaluation of Alternative 5 would be needed during the remedial design phase.

5.3.5.1 Alternative 5 - Description. The construction of a GCW consists of mixing in-situ alluvial soils (typically clay and sand) with injected grout to construct a continuous low permeability wall that will contain contaminated groundwater within the property. The base of the GCW will be keyed into weathered bedrock. The feasibility level concept is that the GCW will be approximately 8,700 feet long, 20-inches wide and 100 feet deep. Technical and preliminary cost information are provided in Appendix D. Semi-annual groundwater monitoring of an off-site groundwater monitoring network is a key part of Alternative 5. The source control measures including leachate and landfill gas removal currently being performed within the North and South Quarry solid waste landfill areas may be improved over time with the addition of a GCW.

5.3.5.2 Alternative 5 - Overall Protection of Human Health and the Environment. Deferred - Conclusions about this criteria are deferred due to the lack of off-site groundwater data. As with each alternative, depending on the off-site groundwater concentrations and risk assessment results (see Section 3.1), the GCW can provide protection to human health and the environment.

5.3.5.3 Alternative 3 - Compliance with ARARs. The GCW would help achieve chemical-specific ARARs by containing COCs on site. Groundwater monitoring would be used to assess when chemical-specific ARARs are achieved on-site and off-site.

5.3.5.4 Alternative 5 - Long-Term Effectiveness and Permanence. The construction of a GCW would be effective for achieving containment and reducing off-site migration. The GCW does not require long-term maintenance. A groundwater monitoring network would be established to assess the effectiveness of the GCW. The groundwater monitoring network and associated groundwater monitoring events would be in place until concentrations are below regulatory or risk based concentrations for 2-3 years or other regulatory approved time period. Monitoring data would be used to assess reduced risk and effectiveness. The construction of a GCW is a reliable alternative that can be verified through effective monitoring.

5.3.5.5 Alternative 5 - Reduction of Toxicity, Mobility, or Volume through Treatment. Reductions in groundwater concentrations in affected off-site areas will occur naturally after installation of the GCW. Natural attenuation of off-site groundwater concentrations will result in a reduction of toxicity, mobility and volume.

5.3.5.6 Alternative 5 - Short-Term Effectiveness. Alternative 5 can be implemented without causing increased risk to the community and workers during construction and implementation. Activities at the Site would be conducted in accordance with an approved HASP.

5.3.5.7 Alternative 5 - Implementability. This alternative can be implemented with the available personnel, equipment and materials. Property access agreements for installation of the monitoring well network installation would be negotiated with individual property owners. Regulatory or local approvals are not anticipated as the GCW installation will be within the property boundary.

5.3.5.8 Alternative 5 - Cost. Preliminary present value cost for the construction of a GCW is $32,780,138.00. A summary of the preliminary costs are in Table 5. In general, the Alternative 5 preliminary cost summary includes the following items (conceptual only):

- Site access/utility coordination,
- Project management,
- Site characterization,
- Groundwater flow model,
- Plans, surveying, utilities,
- Containment wall design,
- Containment wall construction,
- Field observation,
- As-built survey, construction completion report,
- Institutional controls,
- Monitoring well network installation,
- Groundwater sampling and testing, and
- Groundwater reporting (semi-annual)

6.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

6.1 Introduction. Results of the detailed evaluation are used to perform a comparative analysis to assess the relative advantages and disadvantages of each alternative. The comparative analysis, in part, can assist with providing the basis for determining a remedial alternative. The five alternatives being considered for the Site include:

- Remedial Alternative 1 - No Action
- Remedial Alternative 2 - MNA
- Remedial Alternative 3 – MNA and Barrier Treatment
- Remedial Alternative 4 – Hydraulic Containment
- Remedial Alternative 5 – Groundwater Containment Wall

Note that each alternative (except no action) includes the use of institutional controls such as a deed restriction which would prohibit the installation of potable water wells on a property to eliminate the possible ingestion of untreated groundwater. A groundwater monitoring program and contingency plans are also common to each alternative (except no action).

6.2 Overall Protection of Human Health and the Environment. Taking no action is not protective of human and the environment because institutional controls are not required and monitoring will not be conducted to identify if groundwater conditions change and cause increased risk. Assuming groundwater contamination at concentrations above regulatory or risk-based levels has not migrated to the west of the proposed off-site monitoring well network and the indoor inhalation pathway does not pose a risk, Alternatives 2, 3, 4 and 5 are protective of human health and the environment.

6.3 Compliance with ARARs. MNA complies with ARARs. Barrier treatment will need to comply with possible ARARs regarding injection of chemicals into groundwater. Pilot testing of barrier treatment will need to evaluate water quality conditions created by injection of treatment materials. Hydraulic containment and groundwater treatment by air stripping will need to comply with air and surface water discharge regulations.

6.4 Long-Term Effectiveness and Permanence. Each alternative (except no action) includes institutional controls to reduce potential exposure to untreated groundwater until cleanup levels are achieved. Alternatives 2 through 5 provide similar levels of long term effectiveness and permanence. Alternatives 3 through 5 may reduce the remedial time frame in comparison to MNA.

6.5 Reduction in Toxicity, Mobility or Volume through Treatment. Alternatives 3 through 5 involve treatment methods that reduce toxicity, mobility and volume of affected groundwater.

6.6 Short-Term Effectiveness. Each of the alternatives would be implemented in accordance with an approved HASP. Barrier treatment could cause water quality conditions due to the injected materials. Additional Site evaluation is needed to assess the potential remedial time frames associated with Alternatives 2 through 5.

6.7 Implementability. Alternatives 2 through 5 would require access agreements and regulatory approvals prior to implementation. Each alternative can be implemented using available methods and technology. Implementation of a barrier treatment may include regulatory approval that is needed for injection of treatment materials into groundwater. Hydraulic containment has the most components associated with implementation (i.e., extraction wells, extensive piping network, substantial treatment system, pipeline construction, permits, O&M requirements).

6.8 Cost. The preliminary present value costs for Alternatives 2 through 5, assuming that treatment and monitoring will require 30 years to complete, are as follows:

Alternative 2	$ 5,640,772
Alternative 3	$13,391,769
Alternative 4	$14,501,653
Alternative 5	$32,780,138

Alternative 2 is the most cost effective alternative. Below is a summary of Alternative 2 costs compared to Alternatives 3 through 5 costs:

Alternative 3 – approximately 2.37 times greater
Alternative 4 – approximately 2.57 times greater
Alternative 5 – approximately 5.81 times greater

Due to the feasibility level and conceptual level definition of the remedial alternatives, in our opinion, the present value costs may be considered within the following accuracy ranges.

Alternative 2:	-30 to +50 percent	cost range $3,948,540 to $8,461,158
Alternative 3:	-30 to +50 percent	cost range $9,374,239 to $20,087,654
Alternative 4:	-50 to +100 percent	cost range $7,250,827 to $29,003,306
Alternative 5:	-30 to +50 percent	cost range $22,946,097 to $49,170,207

APPENDIX A

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ENGINEERING MANAGEMENT SUPPORT, INC. REPORT

(Please see separate PDF files for appendices)

APPENDIX B

BARRIER TREATMENT - TECHNICAL AND COST INFORMATION BY REGENESIS

APPENDIX C

AIR STRIPPING TREATMENT COST INFORMATION
QED ENVIRONMENTAL SYSTEMS

APPENDIX D

GROUNDWATER CONTAINMENT WALL
HAYWARD BAKER INC.